

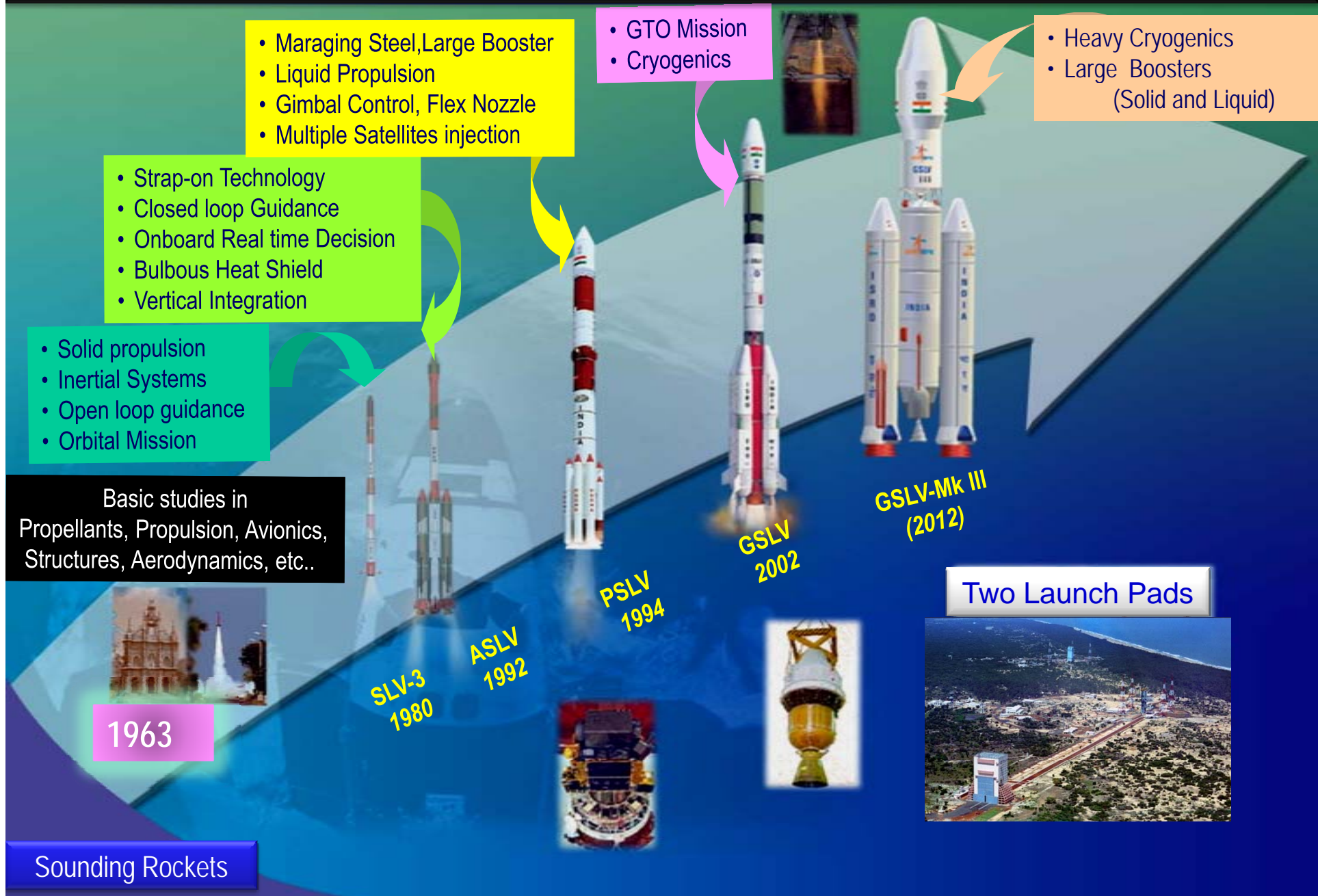


‘Access to Space’

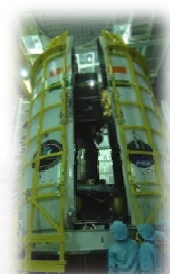
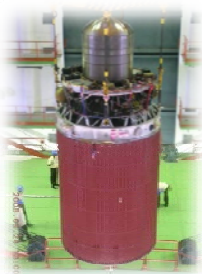
ISRO’s Current Launch Capabilities & Commercial Opportunities

S Somanath
Project Director, GSLV Mk III
VSSC, ISRO

Indian Strides in Space Transportation System 1963 - 2010



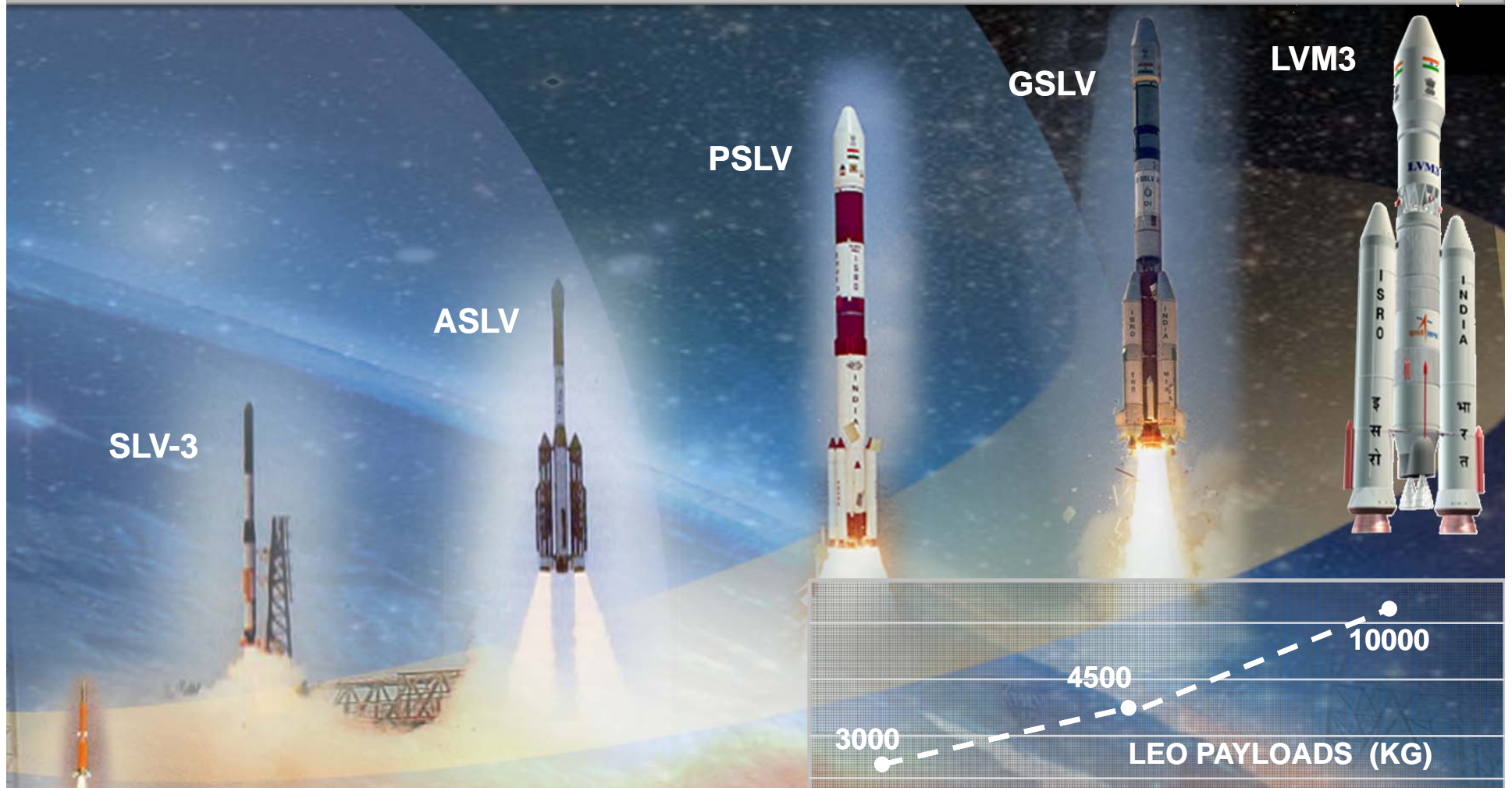
Launch Complex facilities



- Two Launch Pads for PSLV, GSLV & LVM3
- Facilities for Launch vehicle integration and storage.
- Multiple Facilities for Spacecraft servicing.

PSLV at Second Launch pad





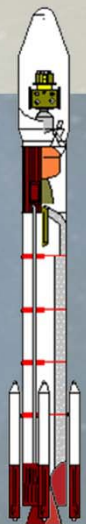
Launch Vehicles of ISRO



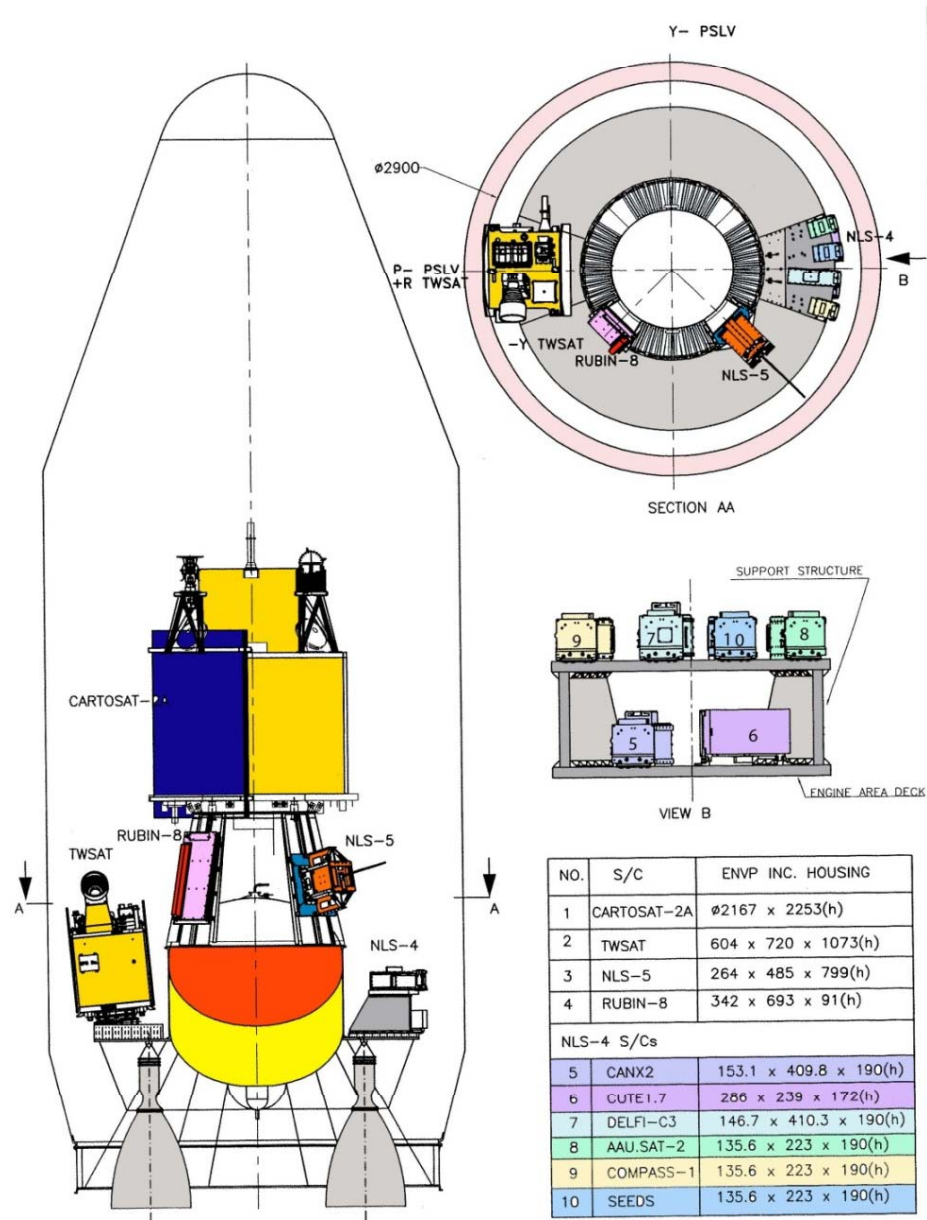
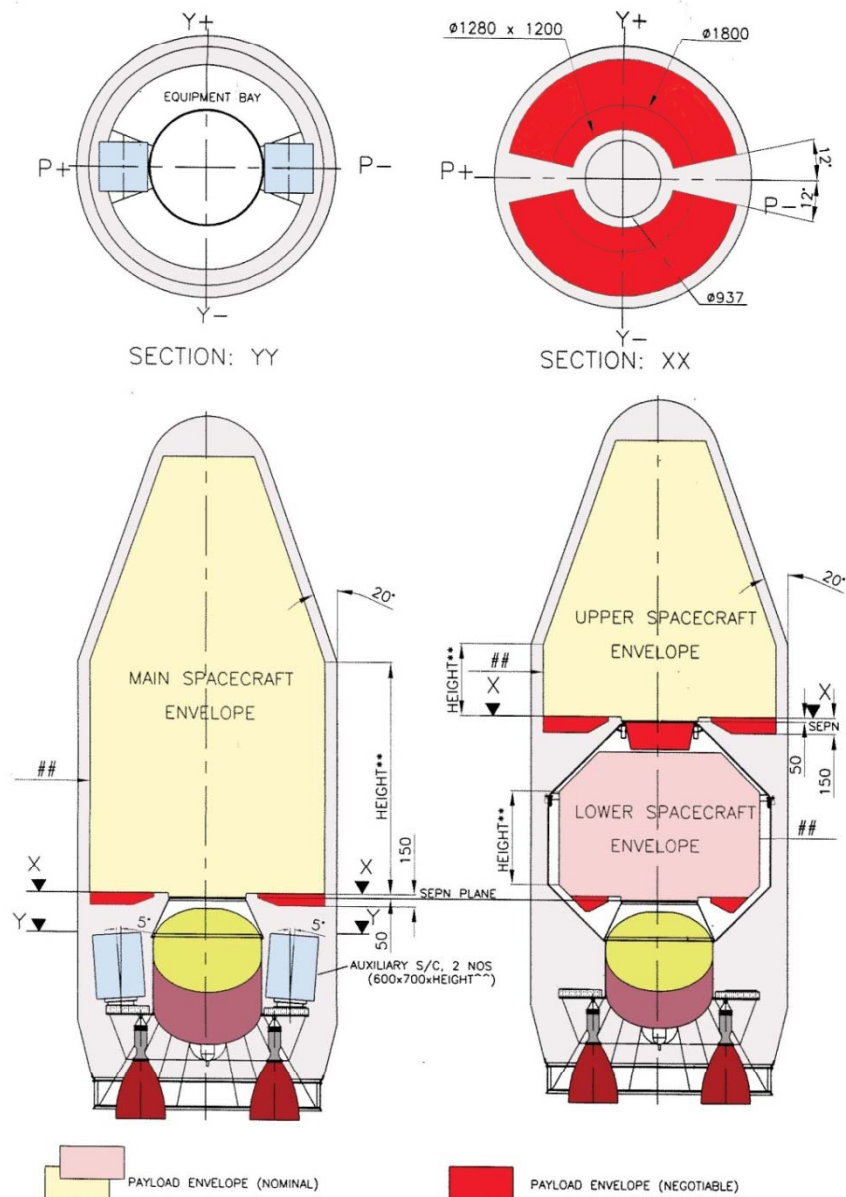
Launch Vehicle	SLV	ASLV	PSLV	GSLV	GSLV Mk-3 (Under development)
Lift-off weight (kg)	17	40	295	450	640
Payload (kg)	40 (LEO)	150 (LEO)	1600 (SSO)	2000 (GTO)	4000 (GTO)

PSLV Variants and Payload capability



PSLV VARIANTS	PSLV	PSLV-CA	PSLV-XL	PSLV-HP	PSLV-3S
					
	BASE CONFIGURATION	CORE ALONE VEHICLE, NO STRAP-ONs	PSLV WITH EXTENDED STRAP-ON (PSOM-XL)	PSLV-XL WITH HIGH PERFORMANCE PS4	PS2 & STRAP-ONs REMOVED
	(6S9 + S139) + PL40+ HPS3 + PS4	S139 + PL40+ HPS3 + PS4	(6S12 + S139) + PL40+ HPS3 + PS4	(6S12 + (S139) + PL40+ HPS3 + PS4	S139 + HPS3 + PS4
	LEO	3200	2100	3800	4000
SSPO (622 Km)	1600	1100	1750	1900	-
GTO (240 x 24000 km)	1150	-	1300	1440	-

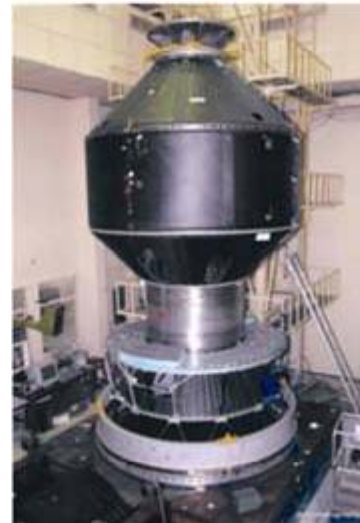
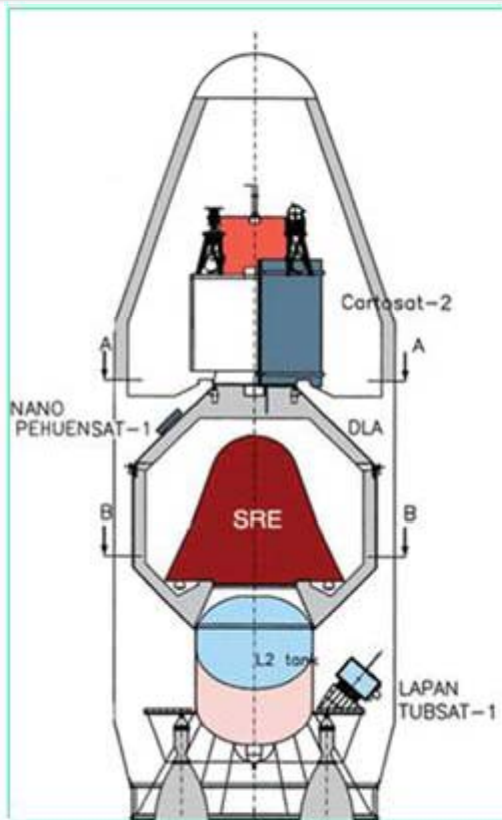
PSLV PAYLOAD ACCOMMODATION



MULTI SATELLITE LAUNCH CAPABILITY OF PSLV

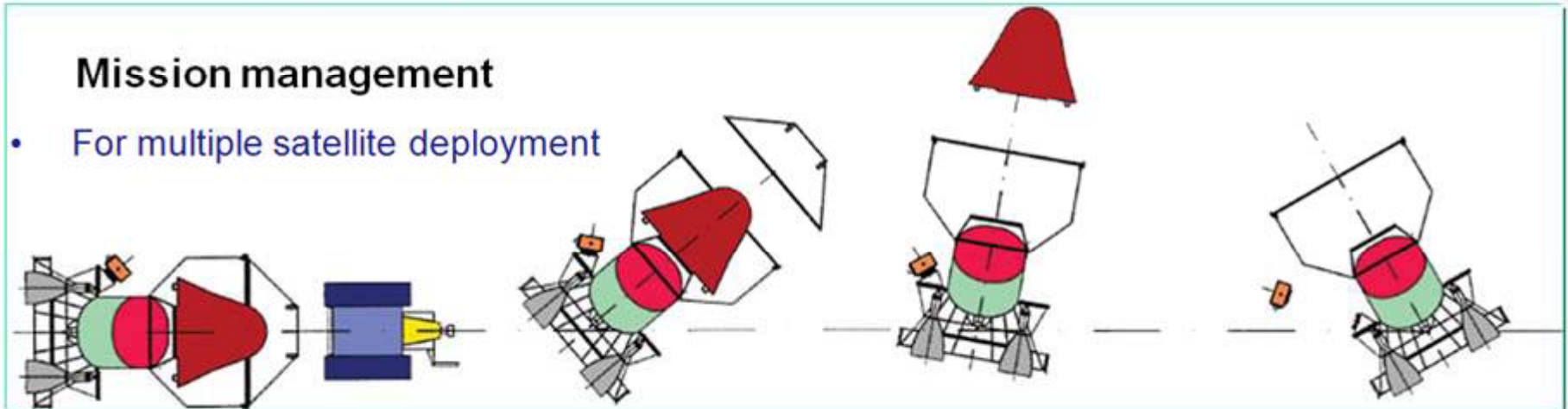


Composite Dual Launch Adapter (DLA)



Mission management

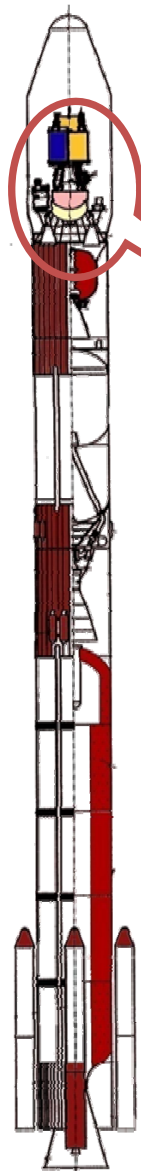
- For multiple satellite deployment



PSLV C9: Spacecraft accommodation



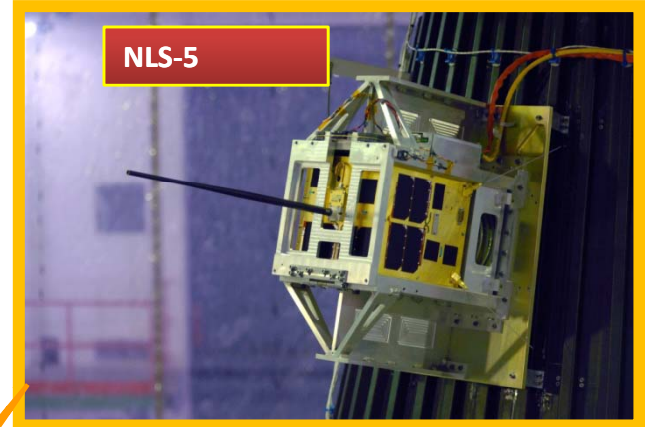
DEPLOYMENT OF TEN SATELLITES



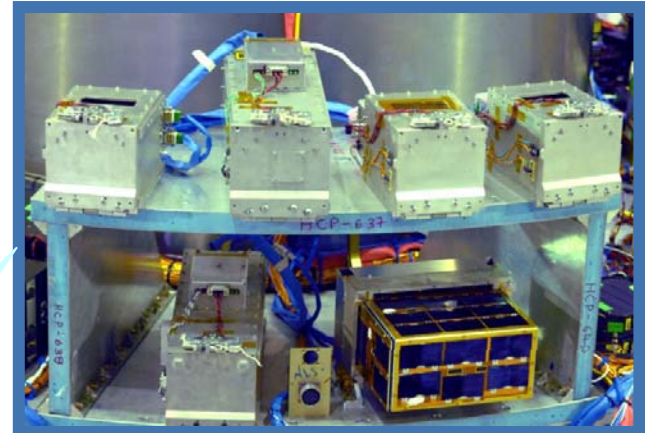
CARTOSAT - 2
INDIA 686 kg



NLS-5



IMS -1
INDIA 83 kg



RUBIN 8
GERMANY

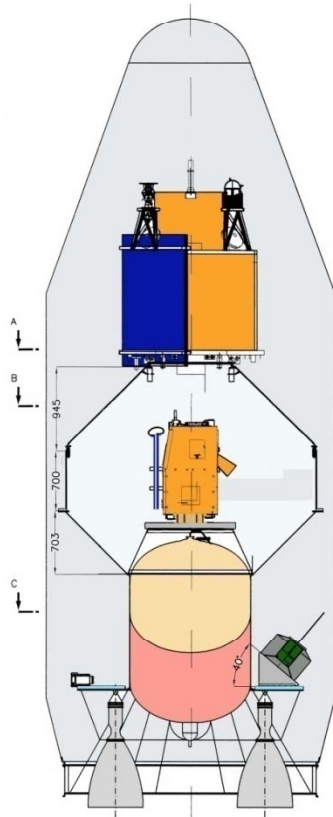


PSLV-C15 / PSLV-C16 Missions



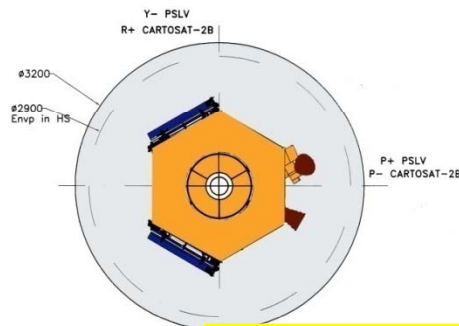
DEPLOYMENT OF MULTIPLE SATELLITES

CARTOSAT – 2B
693 kg

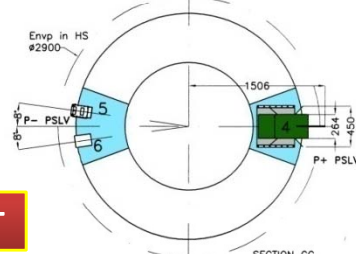
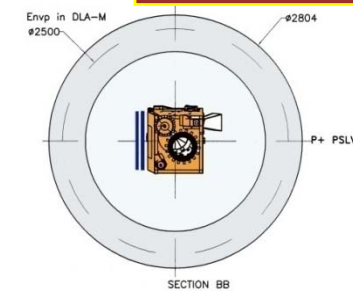


NLS 6.1 /6.2

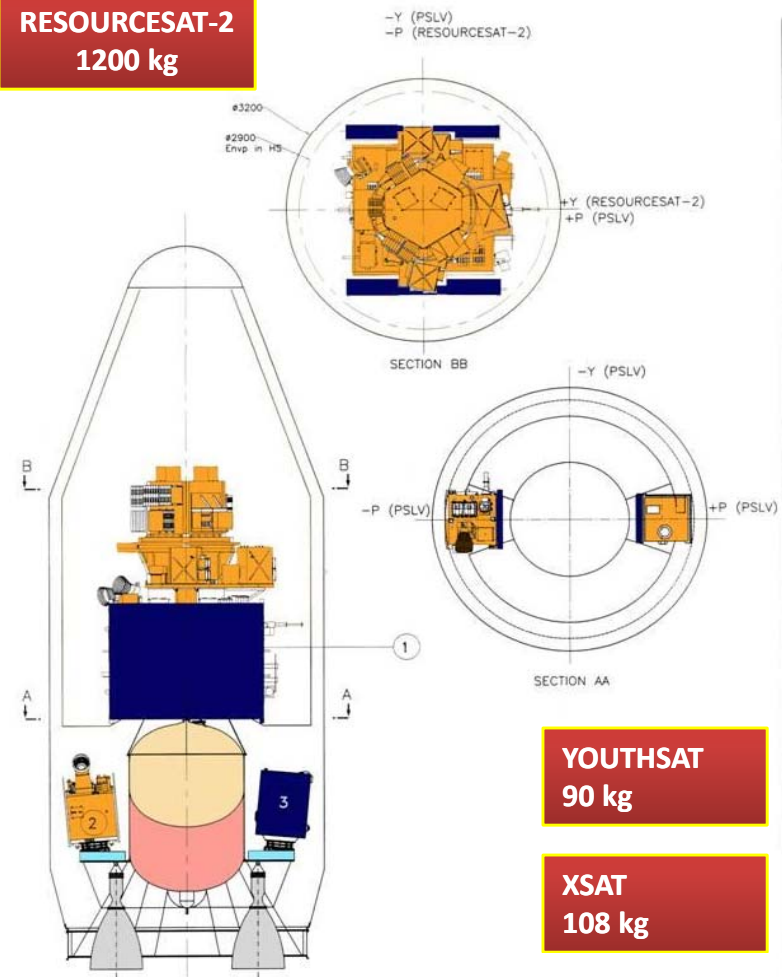
STUDSAT



ALSAT-2A
116 kg



RESOURCESAT-2
1200 kg



YOUTHSAT
90 kg

XSAT
108 kg

637.3 km SSPO

822 km SSPO

GSLV Variants



GSLV MkII

GS1: (4L40H+S139)
GS2:L37.5H
GS3:C12



GSLV MkIIA

GS1:(4L40H+S139)
GS2:L37.5H
GS3:C15

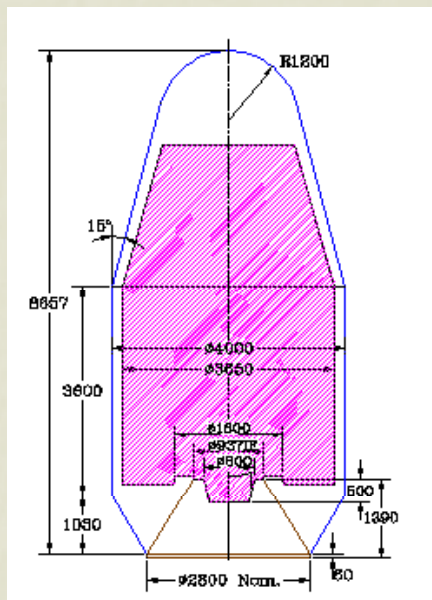


GSLV MkIIC

GS1:(4L40H+S139)
GS2:L40H
GS3:C15
GS4:PAM

GTO CAPABILITY

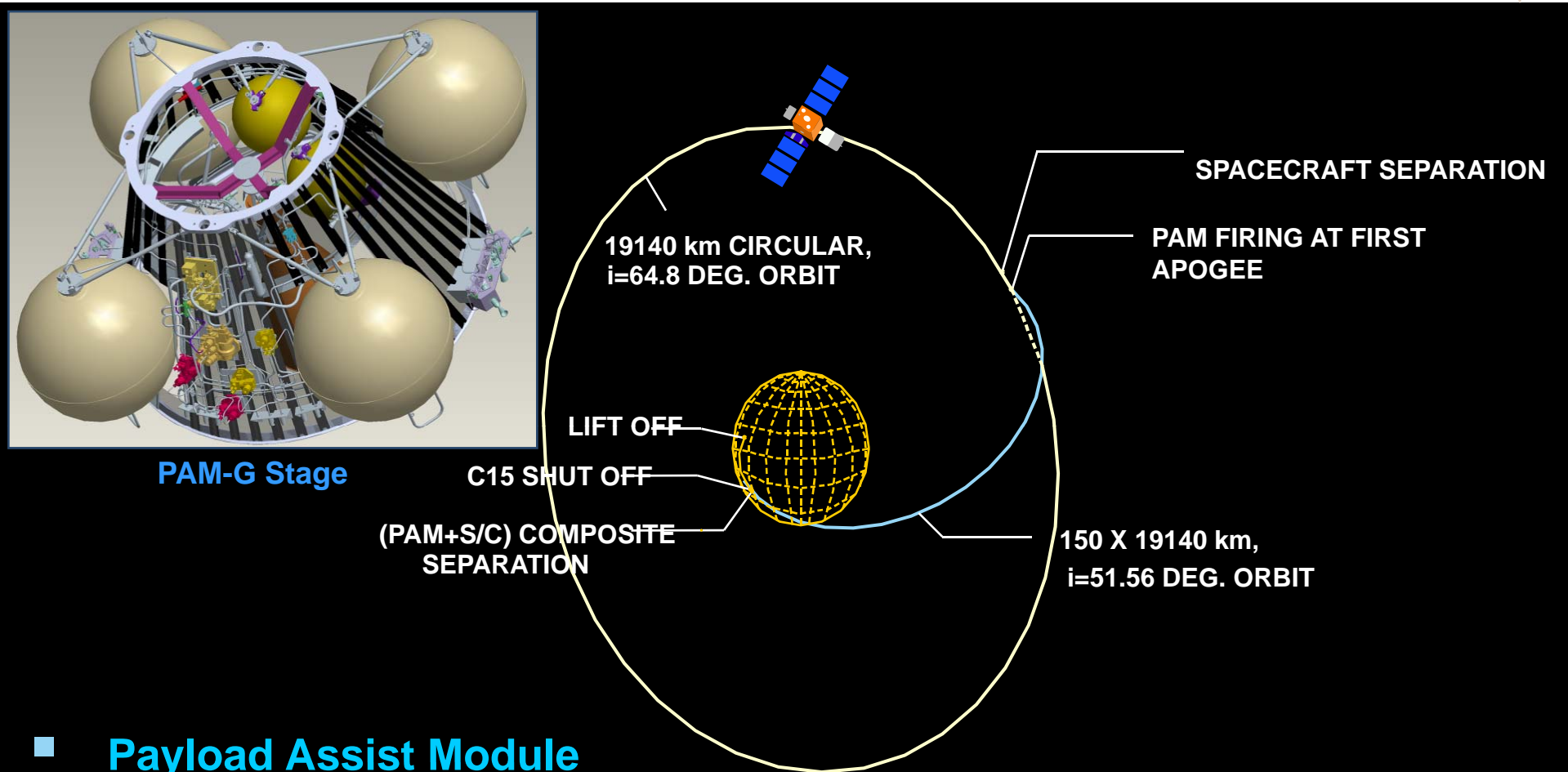
	Orbit size, Incln (km x km, deg)	P/L (kg)
GSLV MK II	170 X 36,000, 20.7	2200
GSLV MK II A	170 x36,000, 19.4	2350



SSPO CAPABILITY

	Orbit size, Incln. (km x km, deg)	P/L (kg)
GSLV MkIIA	700 x 700, 98.2	3100

MEO Mission for Navigation satellites



- **Payload Assist Module (PAM-G) for direct injection to the orbit**
- **GEO direct injection capability : 955 kg**

Spacecraft mass: ~1400 kg
Orbit : 19140 km circular
Period : 11 :15 : 40 hr
Inclination : 64.8 deg

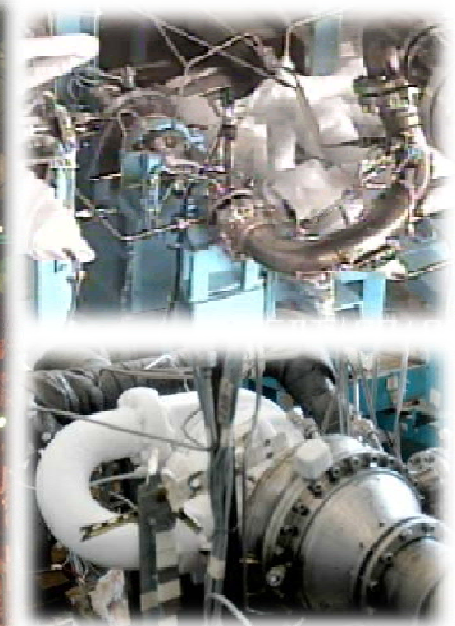
LVM3 DEVELOPMENT

CONFIGURATION

2S200+L110+C25



L110 stage test



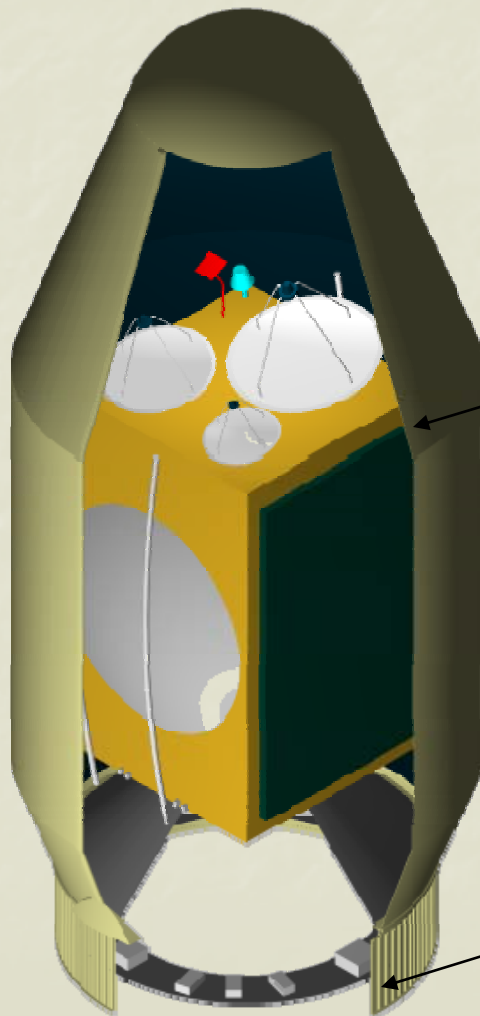
C25 TP tests



S200 static test

PAYLOAD ACCOMMODATION OPTIONS IN LVM3

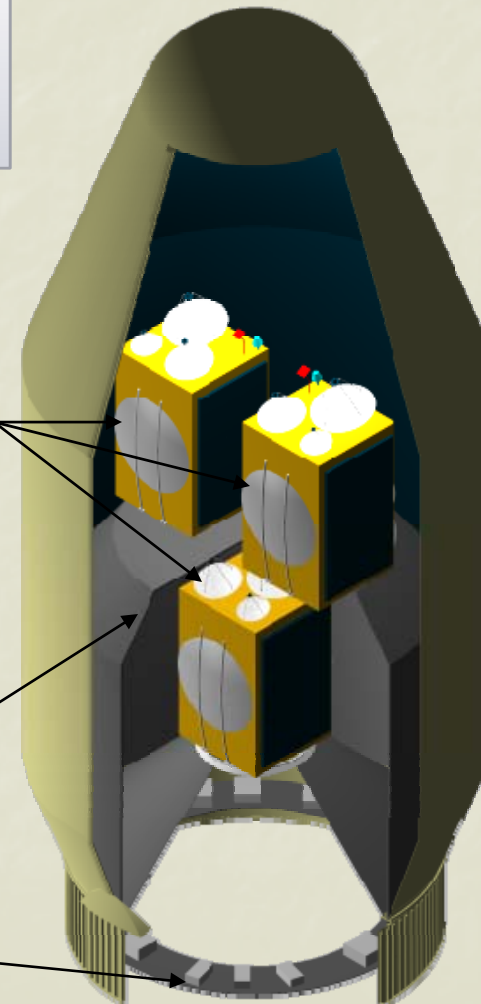
SINGLE PAYLOAD



Payload Envelope: 4.5m
Diameter, 5 m height,
110 m³ volume

**SINGLE
PAYLOAD**

MULTIPLE PAYLOADS



**MULTIPLE
PAYLOADS**

**DUAL
LAUNCH
ADAPTER**

EQUIPMENT BAY

Capability for Lunar & Inter – planetary missions



Lunar capabilities

Launch Vehicle	EPO Size (km x km)	EPO mass (kg)	LPO mass (kg)
PSLV	250 x 22860	1380	720
GSLV MkII with CUS12	170 x 36000	2233	1174
	170 x 24000	2533	1220
GSLV MkII with CUS15	170 x 36000	2457	1294
	170 x 24000	2757	1332
GSLV Mk III	180 x 36000	4283	2285

Inter-Planetary capabilities

Launch Vehicle	Orbital capabilities (kg)	
	Moon (LPO)	MARS
PSLV	720	150 – 230
GSLV	1294	350 – 530
LVM3	2285	650 – 1010






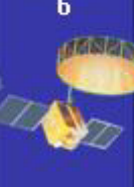







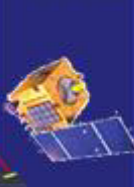
















2012

TOTAL SANCTIONED COST: Rs 3233 Cr

**Total cost F1 to F16:
Rs 3551 Cr**

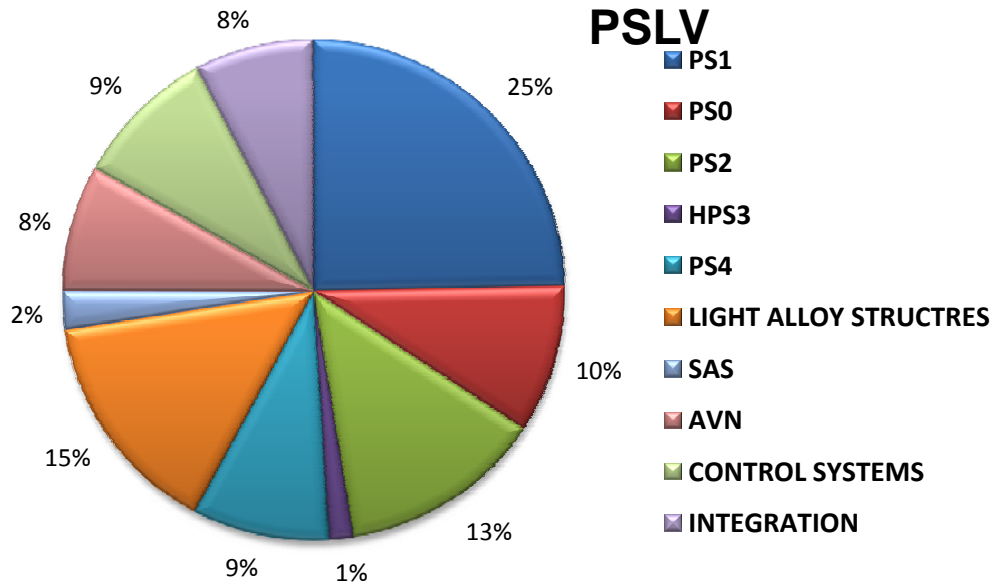
GSLV MkII Launch Manifest



2009 Q III	2009 Q IV	2010 Q I	2010 Q III	2011 Q I	2011 Q III	2012 Q I	2012 Q III	2013 Q I	2013 Q III	2014 Q I	2014 Q III	2015 Q I	2015 Q III
GSAT 4	INSAT 3D	GSAT 5	GSAT 6	GSAT 7	Glonass M	GSAT 8	Glonass M	GSAT 12	GSAT 13	IRNSS	Chandr ayaan II	IRNSS	GSAT 14
													
													
D3	F06	F05	F07	F08	F03	F09	F10	F11	F12	F13	F14	F15	F16
Dev. Flight	Operational flights												

UNIT COST OF LAUNCH VEHICLES

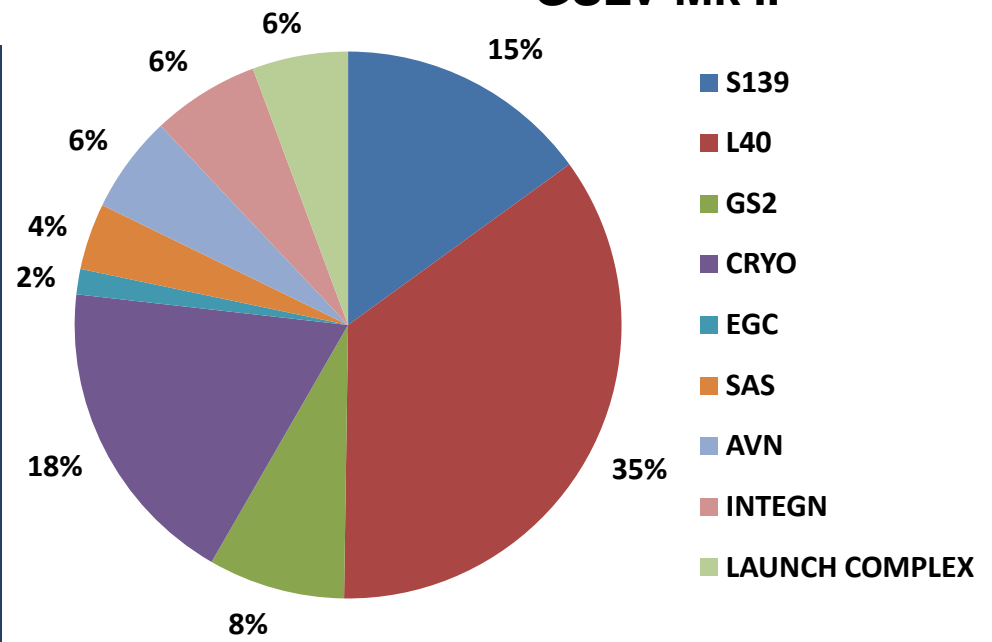
PSLV



Cost break up for launch vehicle

- Fabrication – 34%
- Materials & bought out items – 57%
- Propellant – 9%

GSLV Mk II

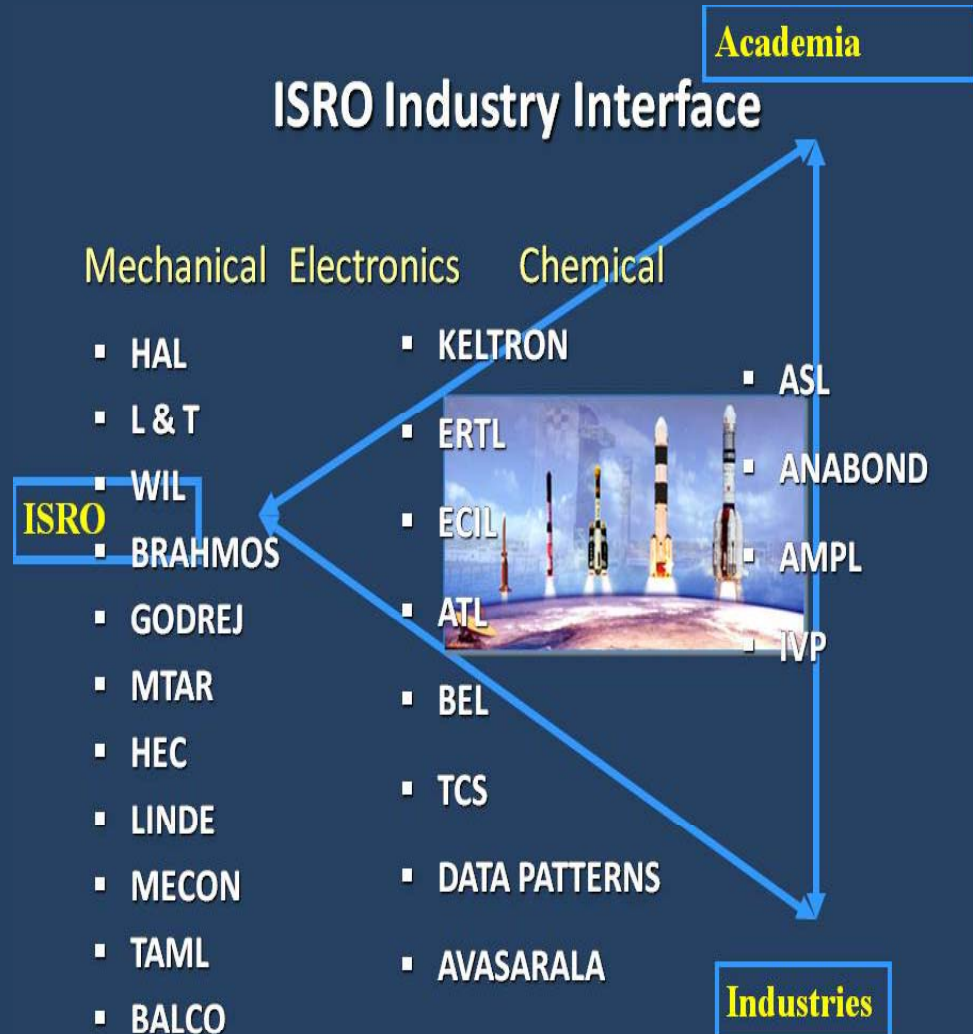


90 % of the launch vehicle unit cost is through industries

CURRENT LEVEL OF INDUSTRY PARTICIPATION



- Interstage structures and tanks production
- Motor cases materials and fabrication
- Liquid Engine subsystems and control components realisation
- Composite systems production
- Production and testing of electronic packages
- Production of liquid & solid propellants
- Production of raw materials
- Subsystem level integration and testing
- Facility build up in ISRO & in industries funded by ISRO



More than 150 industries all over India

Industry participation in Propulsion systems realisation

Vikas Engine

M/s Godrej &
M/s MTAR
M/s Brahmos



Propellant tanks

M/s ASD HAL –
PS2/GS2/L40/CUS/L1
10/C25

M/s Bhramos
Aerospace – L40



L40 Stage Integration



M/s ASD HAL

CUS Engine/ C25 Engine

M/s Godrej &
M/s MTAR



Components & Modules

M/s MTAR – PS2/GS2/L40/
S/c Valves
(IPCM)



M/s LTE –
TVC/RCT/PS4/PAM/
S/c Valves
(IPCS)



M/s LTE – DC torque motor
for TVC &
DC motor for motorised
valves

S/C propellant tanks

M/s BHEL
M/s/KCP



Propellant production – UH25, MMH, LH2, N2O4
M/s ASL , M/s HOCL

Umbilical

M/s Microfine
Bushings

Bellows & Metallic
flexible hoses- HRCM
Hoses/TVC Hoses/L40
Hoses

M/s Metallic Bellows

PTFE Flexible Hoses
M/s MIL Ind.

PS4 Engine

M/s ASACO



Transducers

M/s LTE
M/s Brahmos Aerospace



LVM3 Development

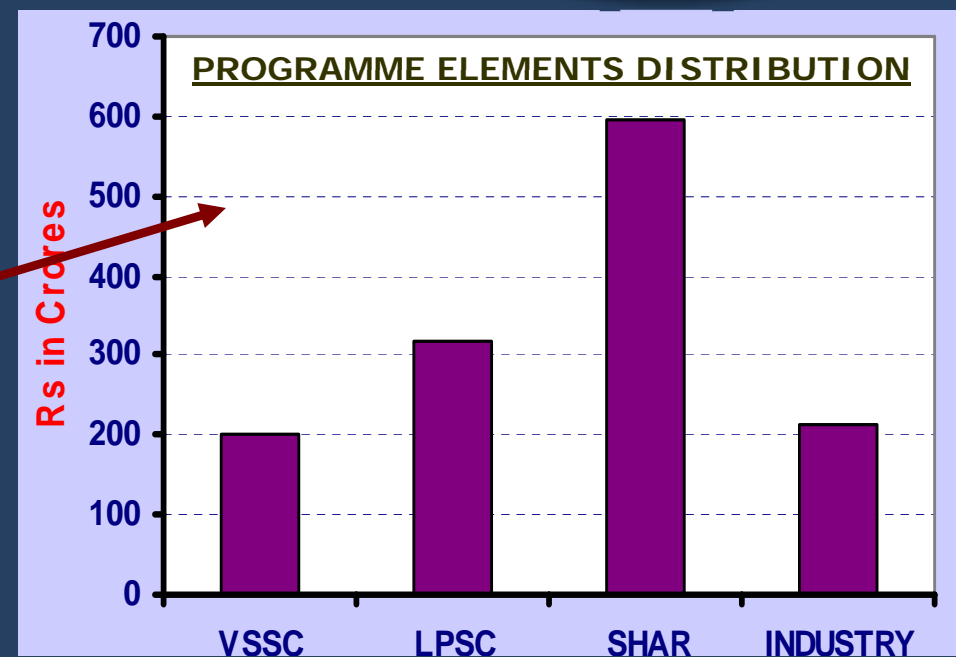
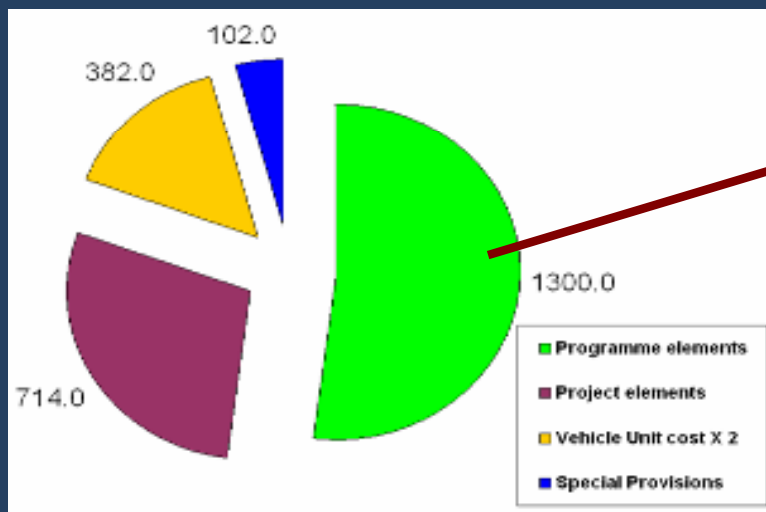
Development & test flight of two vehicles including facility build up.

MAJOR FACILITIES



1. VEHICLE SYSTEMS FACILITIES AT VSSC
2. L110 & C25 INTEGRATION & TESTING FACILITIES AT LMF / LPSC
3. STRUCTURAL TEST FACILITIES AT VSSC & SDSC
4. MANUFACTURING FACILITIES AT WORK CENTRES
5. SOLID PROPELLANT PLANT AT SDSC
6. LAUNCH COMPLEX FACILITIES

Rs. 1300 Cr for facility build up



Production throughput required from industry

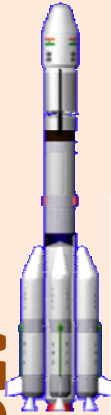


4 PSLV



- PS1 motor cases
- PS0 motor cases
- Light alloy structures
- Propellant tanks
- Vikas Engines
- Precision components
- Avionic sub assemblies
- Integration & testing

2 GSLV



- GS1 motor cases
- L40 stages
- Propellant tanks
- Vikas Engines
- CUS engines
- Precision components
- Avionic sub assemblies
- Integration & testing
- Light alloy structures
- Composite hardware

1 or 2 LVM3



- 4 m dia light alloy structures
- 5 m dia CFRP heat shield
- Propellant tanks
- 3.2 m dia motor cases
- Vikas Engines
- C25 Engines
- Precision components
- Avionic sub assemblies
- Integration & testing

Batch Production in industrial environment considering economy of scale

Integration of Stages and Assemblies by Industry

Indigenization of materials

Indigenous facilities for Material processing

Facility build up for new projects on turn key basis

Conclusion

Launch Capability Development

- PSLV payload capability, Mission flexibility, GSLV launch capability
- LVM3 to provide 4 ton to GTO capability by 2012.

Launch Service Opportunities

- Mini/Mico satellite launch capability in PSLV. Various spacecraft dispensing schemes developed and qualified.
- Limited dedicated launch feasibility exists in PSLV & GSLV for various types of missions

Industry Participation

- 60 % of 11th plan outlay was planned through Indian industries. Policy to have Industry as a risk sharing partner in the future endeavors of ISRO.
- Increased throughput from industries to cater to the higher launch frequency planned.

Thank You

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